INTUSSUSCEPTION.*

BY JOHN D. RUSHMORE, M.D.,
OF BROOKLYN,
Surgeon to Long Island College Hospital and St. Peter's Hospital.

THIS paper deals with the consideration of cases of intussusception during the first twenty-four hours after the onset of the disease. In order to collect a sufficiently large number of cases from which to draw fairly definite conclusions, Dr. Daniel Lewis, editor of the *Medical Review of Reviews,* has at my request had a search made through the files of that journal of cases reported during the last five years. The list of 203 cases furnished me by Dr. F. Robbins, to whom my thanks are due, with 96 cases by Clubbe in a brochure kindly loaned me by my friend Dr. Charles T. Poore, and two of my own cases not hitherto reported, make a total of 301 cases. Of these, 194 were males and 92 females. In the other cases the sex is not given. Males are therefore about twice as liable as females to this disease; and these figures confirm what has many times been stated with reference to the relative frequency of intussusception in the sexes.

Evidence furnished by the material at my disposal has a somewhat important bearing on the etiology and diagnosis of intussusception, but especially on its prognosis and treatment.

The conditions that favor the development of intussusception are evident enough; but the exciting cause still remains obscure. The age, the relatively long mesentery, the presence of the ileocæcal valve at the termination of the small intestine and the larger lumen of the cæcum and the colon beyond, the circular disposition of the muscular fibres, are all favorable anatomical conditions for an intussusception; and the physiological action of the intestinal tract with its sometimes irregular muscular contractions add to the risk of the development of the disease; for in the normal action of the intestinal muscles the subject is all the time on the border of an intussusception. These conditions, however, never of themselves produce trouble. The immediate cause must be sought elsewhere. I think the study of statistics and experience in the treatment of intussusception will impress one with the important part that the contents of the intestines play in the immediate causation of the disease. Once started the condition is easily explained; but the generally accepted etiology seems to lack a starting point. Treves says, " There is practically unanswerable evidence to show that intussusception is brought about by irregular action in the muscular wall of the intestine." This is undoubtedly true, but it leaves us ignorant of the cause of the irregular action of the muscle. Nothnagel says, " If I understand this matter correctly, true sequence of events is the following: While the bowel is performing normal peristaltic movements an annular and strictly local constriction of the bowel happens to occur. This constriction may be greater than normal and so pronounced that the limit of physiologic invagination is exceeded and the first degree of pathologic intussusception develops, exactly in the same manner as it has been seen to do in our experiments. It is quite unnecessary to invoke any primary causative factor; what is needed is a simple increase in the intensity of the normal movement of the bowel, which of itself is sufficient to produce this dangerous condition. On this basis, too, the great predominance of invagination of the bowel in early childhood can be satisfactorily explained, for it is usually admitted that at this age the bowel is more irritable and more mobile than in later life. The proof of this assumption is that the so-called agonic form of invagination is most frequently found in the bodies of children."

---

* Read before the New York Surgical Society, April 10, 1907.

This explanation would seem to be inadequate to account for the very beginning of an invagination. The irregular muscular contraction does not " happen to occur," but must be due to some temporary cause differing from the constantly present conditions that favor the development but never by themselves cause invagination. It seems reasonable, as noted above, that the starting point may be found in the presence of material inside of the gut, which by its bulk or by chemical irritation excites the spasm or irregular muscular contraction which is essential in any form of intussusception. The spasm by itself is not sufficient to cause the invagination. In the diarrhœal diseases of children there is pain, irregular muscular contraction, spasm, increased peristalsis, increased irritability and irritation, but invagination occurs so seldom that it may very well be doubted whether the invagination has been due to these causes alone. If there is added to these conditions a mechanical obstruction furnished by the contents of the intestine, the invagination is not difficult to explain. And, recognizing the existence of reversed peristalsis, which may be present in any form of acute obstruction of the intestine, it is not more difficult to account for the rare cases of retrograde invagination than for the direct form. If we examine the varieties of intussusception the evidence in support of the idea that mechanical obstruction is the primary cause of invagination is strengthened; for in by far the largest number of cases the lesion is found at or near the ileocæcal valve; a few occur in the large intestine, still fewer in the small intestine and 8 out of 14 cases reported in the small intestine had a diverticulum at the lower end of the intussusception. These diverticula located in the lower part of the ileum, where the bowel contents are acquiring a less fluid character, furnish a ready starting point for an invagination. The list below gives the location of invagination in my cases where it is definitely stated:

Ileocæcal	140
Ileocolic	31
Enteric-ileocæcal	13
Ileocolic-ileocæcal	4
Diverticulo-ileac	4
Colic	6
Cæcal	2
Cocolic	3
Ileo-appendix	1
Transverse colic	1
Diverticulum	1
Cæcum-ascending and transverse colic	1
Meckel's diverticulum	1
Diverticulo-enteric	1
Retrograde-enteric	1
Diverticulo-ileo-ileocolic	1
Ileocolic and iliac	1
Double	19
Double iliac	1
Iliac	2
Enteric	3

In all 237 cases. Fourteen in the small intestine, 17 in large intestine, and the rest, 206, combined. A consideration of the above figures and the conditions that are anatomically and physiologically present in intussusception makes it at least reasonable to think that a mechanical cause, as above suggested, was the starting point in invagination. The so-called agonic forms of this disease which are found in the lower intestine, small in size, not infrequently multiple, and sometimes retrograde, producing no symptoms, are more probably due to centric causes, and seem entirely different from the cases considered in this paper.

In this connection I desire to present two patients who have recovered from intussusception, together with a brief history of each case.

CASE I.—Male, nine years of age, sent into hospital by Dr. C. J. Noonan, May 23, 1906, with the history of having been seized with sudden violent pain on the street twenty-two hours before he entered the hospital. There had been some nausea, but no vomiting; frequent desire to stool, but no passage of blood or mucus, temperature normal, from the beginning; pulse normal first twelve hours, about 110 in hospital; no shock at any time, slight distention; a tumor, first recognized after twelve hours, between gall-bladder and umbilicus, about six inches in length, tender on slightest pressure. The boy had had three injections without effect, except a slight streak of blood after one of them.

Immediate laparotomy under ether and delivery of tumor. It was interesting to observe after partial reduction and letting up on traction the intussuscipiens sliding up over the intussusceptum instead of the intussusceptum gliding downwards into the intussuscipiens. The upper end of the sheath was slit-like from traction by mesentery and not round. There was no spasm, indeed, by very slight pressure the finger could be easily inserted for a distance of two inches between the sheath and the intussusceptum. Traction had little effect in reduction. The mass, with the exception of the last inch or two, was easily reduced by combining traction with pressure and by utilizing the intestinal gas below the mass and employing the process that the farmer uses in milking, but in reverse direction, flexing the little finger strongly, and then the ring, middle and first finger successively; in this way sufficient pressure was made on the gas locked up between the fingers and the intussusceptum to distend the sheath and also press out some gas and blood from the intussusceptum and to render the reduction easy. The lower end shot out by a little added pressure and revealed a much swollen diverticulum. Fourteen inches of gut were gangrenous—the lower end of demarkation very distinct, the upper line rather ill-defined. The mesentery was twisted on itself and was untwisted in the reduction. The whole mass was excised; end-to-end anastomosis with continuous glover's suture through all the coats, using No. 2 plain catgut, secondary continuous Lembert suture in peritoneal coat with No. 1 plain catgut, suture of mesentery, layer sutures for abdominal wall; rectal feeding three days; normal bowel action third day without drugs, moderate febrile reaction for four days. Satisfactory recovery and the boy remains well after seven months.

CASE II.—Female, seven months old, seized with pain suddenly at twelve midnight, vomiting immediate, blood and mucous stool within an hour. Seen by Dr. F. C. Paffard about three P.M.; temperature 99½; pulse 140; tumor in left iliac fossa; no shock, no tympanites; only on deep pressure over tremor was there tenderness; child looked well; laparotomy under ether seventeen hours after onset of symptoms; ileocæcal variety; felt in rectum, reduction easy except last three inches; slight dimple left in caput coli; layer sutures; vomited for twenty-four hours, but nursed also, bowels moved by enæma third day; temperature was about 100, subsequent recovery smooth.

Both of these cases furnish the ordinary symtomatology of intussusception, and illustrate both what we may and may not be expected to find as a basis for our diagnosis.

Osler says, "Intussusception is an affection of childhood and is of all forms of internal obstruction the one most readily diagnosed. The presence of tumor, bloody stools and tenesmus are the important factors. The tumor is usually sausage-shaped and felt in the region of the transverse colon. It existed in 66 of 93 cases. It was present on the first day in more than one-third of the cases, on the second day in more than one-fourth, and on the third day in more than one-fifth. Blood in the stools occurs in at least three-fifths of the cases, either spontaneously or following the use of an enæma. The blood may be mixed with mucus. Tenesmus is present in one-third of the cases. Fæcal vomiting is not very common and was present in only 12 of the 93 instances. Abdominal tympany is a symptom of slight importance, occurring in only one-third of the cases."

An examination of the details of cases so far as they are given by the different reporters will justify the following statements: The disease occurs among previously healthy children in a large majority of cases, and any previous illness in the small minority has little or nothing to do with the causation of the invagination. The attack is sudden, characterized by severe paroxysms of pain and pallor. It is noticeable how seldom shock is mentioned as a symptom in the reported cases. The statement is emphasized that most of the patients after the pain ceases look well. Clubbe says, "the child may not look ill, its pulse rate may be hardly varied and its temperature may be normal." It is to be noted that he is speaking of cases seen in the first few hours. So-called shock symptoms develop later and are symptoms rather of collapse or sepsis than shock. Tympany is not a prominent symptom except late, when inflammatory symptoms occur. I should think the tumor, if the examination is properly made, would be found in more than 66 of 93 cases. Clubbe states that in his cases (124) "as a mass is invariably present in cases of intussusception, it should be possible to make it out if we examine carefully. I can only remember two cases in which I opened the abdomen without first feeling the mass. In these cases there was much distention, but the history and the symptoms were characteristic." In doubtful cases a general anæsthetic ought always to be used and bimanual palpation employed, remembering how the mass may slip away and reappear, or be hidden about the hepatic or sigmoid flexure of the colon, and that it may not always be sausage-shaped. We must not expect rectal examination to throw much light on these early examinations, nor in the less frequent cases where the small intestine is the seat of the disease. The bloody stools with mucus and tenesmus are present in 97 per cent. of Clubbe's cases within from two to ten hours. The tumor can be recognized as early as three hours after onset of symptoms. Judging from the agonic forms of invaginaton that occur just before death it is certain we should not be able to feel the tumor in a living subject immediately after the first paroxysm of pain; but in one case it was felt at the end of two hours. Intestinal or fæcal vomiting has been noted in comparatively few cases and in those as a later symptom. In almost all cases we shall rely for diagnosis on the sudden attack of severe abdominal pain, blood and mucous stools, tenesmus and tumor. Where rectal symptoms are absent and the others present, I should feel that the disease was in the small intestine as the discharges come directly from the mucous membrane of the colon, and in the enteric form must be present as a later symptom.

The prognosis of intussusception and the effect of prompt and late resort to operative measures is well shown in the following table by Weiss:

321 CASES FROM 134 PUBLICATIONS.

	New born infants.	Children up to puberty.	Adults.
Conservative treatment	16%	22%	26%
Immediate laparotomy	61%	90%	85%
Late laparotomy	54%	50%	50%

In regard to the treatment of intussusception, all the reports with no exception emphasize the necessity of early treatment. One reports success in a large percentage of cases by taxis; some are in favor of injections, inflation or manipulation, separately or combined, as a first resort, and laparotomy in those cases in which these measures fail. The rest are in favor of immediate laparotomy. The favorable results from taxis are shown by the following report of the experience of Hirschsprung: " The author reports 107 personal observations on intussusception in children, varying in age from seven weeks to seven years (77 boys and 30 girls). Of these 107 patients, 65, 60, 75 per cent. recovered. Laparotomy was rarely required, since taxis, under general anæsthesia usually led to a cure. It was rendered very evident that the prospects of recovery improve with the prompt institution of the treatment after the onset of symptoms. The duration of the disease before hospital treatment could be ascertained in 84 of these cases, and may be divided into three groups:

1. Admission twelve hours after onset of disease. 15 children. Died, 1 child. Percentage of deaths, 6.07.

2. Admission between twelve and twenty-four hours after onset. 28 children. Died, 10 children. Percentage of deaths, 35.7.

3. Cases over twenty-four hours old. 41 children. Died, 22 children. Percentage of deaths, 53.66.

Of the forty-four children under one year of age (25 boys, 19 girls), 70 per cent. recovered if the disease had lasted less than twenty-four hours; if longer, only 30 per cent. recovered. The duration of the disease increases in importance with the youth of the child."

In regard to the use of taxis, injection, inflation or inversion there may be two very important objections urged:

First, That the condition of the intestine can never be known. It is true the probability of gangrene in cases treated early is less than when treated late, but this is by no means always true, for in the cases tabulated below the gut was found gangrenous in eight fatal cases when the operations had been performed within twelve hours from the onset of symptoms, one as early as three and one-half hours, two in six hours, one in ten hours, one in eleven hours, and three in twelve hours, and one in a " few hours;" and besides, as in my own reported case there may be no systemic symptoms to indicate the presence of gangrene.

Second, There is a doubt after using any of these measures as to its success. We can never be sure, except by waiting, and so possibly losing valuable time, whether the invagination has been entirely reduced; for vomiting may continue after reduction and the bowels fail to act for a day or two, fever be present and some tenderness. On the other hand, it is recognized that there is some danger in exposure of the intestine to the atmosphere and even more in the direct handling of it, in reduction; but it may be that these dangers have been over stated, and that they may be attributed, in some cases at least, to our over zealous efforts by drugs and enemata high and low and too long abstinence from food before operation, to too prolonged efforts to disinfect the intestine which may after all be only germ infested and not germ infected. The advantages, however, of direct manipulation of the gut through an abdominal wound, and being able to see what is being done, so far outweigh the dangers that it would probably be better in all cases to omit the employment of all other means and do an immediate operation. In doubtful cases a general anæsthetic will aid in a diagnosis, and we should give the patient the benefit of the doubt by operating at once rather than wait for future symptoms to develop.

In those cases where means other than operation were employed, water injection has failed in about 12 cases, in one of which the seat of the invagination was in the small intestine; water injection was successful in 5 cases, in one of which laparotomy demonstrated the success of the enæma.

In one case water had been used with apparent success, but was found to have failed by the laparotomy. Massage and inflation used in one case failed. Inflation failed in one case. In one case the invagination was shown by the laparotomy to have reduced itself.

The influence of age and the time of operation after onset of symptoms is well shown in the following table.

Figures, as far as they can be depended on, would therefore prove that age exerts a very material influence in the prognosis of intussusception, that the mortality on account of age alone is practically twice as great during the first six months of life as after eighteen months. When the element of time is made the basis of prognosis the greatest encouragement is offered.

Wiggin, quoted by Warren, says, "Counting only the operations that have been performed since the perfected technic of abdominal surgery has become generally known—since 1889—and throwing out those cases in which the operation was not

Age	Number of cases.	Recoveries.	Deaths	Interval in hours in fatal cases from onset of symptoms to operation.
2½ months	1	1	0	
2¾ months	1	1	0	
3 months	11	7	4	18, 24, 24, 24.
4 months	27	18	9	24, 24, 24, 24, 24, 30, 22, 16, 19.
16 weeks	11	1	0	
5 months	41	29	12	25, 19, 17, 18, 21, 12, 24, 6, 24, 12, 24, 24.
6 months	43	32	11	6, 28, 18, 11, 20, 24, 12, 24, 16, 16, 8.
7 months	32	27	5	20, 24, 25½, 12, 22.
8 months	21	17	4	26½, 24, 24, 6.
9 months	25	16	9	72, 17, 3½, 15, 24, 24, 12, 24, 18.
10 months	14	12	2	24, 10.
11 months	6	5	1	24.
12 months	6	4	2	18, 24.
13 months	3	3	0	
14 months	1	0	1	48.
15 months	3	3	0	
16 months	1	1	0	
18 months	3	2	1	12.
20 months	1	0	1	39.
21 months	1	1	0	
22 months	3	3	0	
24 months	1	1	0	
26 months	1	1	0	
27 months	4	3	1	24.
30 months	1	1	0	
32 months	1	1	0	
3 years	3	2	1	15.
3½ years	2	2	0	
4 years	2	2	0	
4¼ years	2	2	0	
4½ years	2	2	0	
5 years	1	1	0	
8 years	1	1	0	
9 years	2	1	1	12.
10 years	1	0	1	24.
12 years	1	1	0	
32 years	1	1	0	
Total,	271	215	66	24.35

		Recovered.	Died.	Death rate.
Number during first six months	125	89	36	28.8
Number during second six months,	104	81	23	22.11
Number during third six months	11	9	2	18.18
Number after third six months	31	26	5	14.82

completed, we have a total of 18 cases of which 14 were successful and 4 unsuccessful, giving a mortality of only 32.2 per cent. This, Wiggin believes, to be a fair estimate of the risk to-day of laparotomy performed on a young infant for the relief of this disorder, if done within the first forty-eight hours of the onset. This gives a chance of success represented by 78 per cent., which, according to this author, would speedily rise to 90 per cent., as the cases come more frequently to operation during the first twenty-four hours.

To what extent this prediction has been fulfilled is shown in the following table made up of the number of cases, recoveries and deaths, by time of operation after onset of symptoms.

It will be noticed from the figures given what a comparatively low mortality will follow operation during the first twelve hours.

The causes of death, when mentioned, were: shock 7, peritonitis 7, collapse 4, cyanotic pneumonia 1, second invagination at post mortem 1, tubercular mesentric glands 1, gangrene 3, marasmus 1, fæcal fistula and pneumonia 1, asthenia 1, hyperpyrexia 1. Twenty cases were subjected to reduction with apparently only two recoveries. Lateral anastomosis was done in one fatal case; death followed in one case of failure of reduction; no definite relation appears to exist between the special variety of intussusception and recovery or death.

The history of cases where gangrene has occurred has up to the present time furnished little encouragement to surgeons; and the experience of writers above recorded corresponds to the general experience of surgeons. The cases almost always have a fatal termination. Only 2 out of 20 cases reported recovered. It is to be noticed that in those 2 cases that the sutures used were a primary continuous through and through suture and a Lembert's continuous suture in peritoneal coat.

The mortality in these cases corresponds closely to the mortality given in Eliot's paper on Acute Intussusception in Young Children. My own successful cases reported above would lead me to think that a primary glover's suture and a secondary Lembert's peritoneal suture is preferable to any other, and that the section of the gut must be made well beyond the gangrenous mass, in healthy tissue, and that the mesentery should be interfered with as little as possible, not cutting into it deeply toward its root, thus leaving the sutured intestine as well nourished as possible.

It is interesting to notice how much advancement has been made in the treatment of intussusception in common with

Time.	Number of cases.	Recoveries.	Deaths.
One and one-half hours	1	1	0
Two "	1	1	0
Three and one-half "	1	0	1
Four "	3	3	0
Five "	2	2	0
Six "	13	10	3
Seven "	11	11	0
Eight "	12	11	1
Nine "	6	6	0
Ten "	11	10	1
Eleven "	3	2	1
Twelve "	25	19	6
Thirteen "	1	1	0
Fourteen "	2	2	0
Fifteen "	2	0	2
Sixteen "	6	3	3
Seventeen "	4	2	2
Eighteen "	15	10	5
Nineteen "	2	0	2
Twenty "	11	9	2
Twenty-one "	2	1	1
Twenty-two "	6	4	2
Twenty-three "	3	3	0
Twenty-four "	54	29	25
Twenty-five "	3	1	2
Twenty-six "	3	2	1
Twenty-eight "	1	0	1
Thirty "	1	0	1
After thirty "	4	0	4
Short time	4	4	0
Few hours	2	2	0
Some hours	2	2	0
Hirschsprung, twelve hours or under	15	14	1
Hirschsprung, twelve to twenty-four hours	28	18	10
Hirschsprung, over twenty-four hours	41	19	22
Total,	301	202	99

		Recovered.	Died.	Death rate.
Cases reported in first twelve hours	112	98	14	12.50
Cases reported in second twelve hours,	136	82	54	39.70
Cases reported after twenty-four hours,	53	22	31	68.90
Total,	301	202	99	32.22

most other abdominal diseases. Bouchut says in 1855, "the diagnosis of intussusception is uncertain and treatment powerless." Tanner, sixteen years later (1871), after speaking of the treatment of taxis says, "supposing these means fail, without absolutely recommending such a procedure, an exploratory incision into the abdomen would appear to be perfectly justifiable in an apparently hopeless case." Even as late as 1881, Ashhurst's statistics gave little encouragement to operate, for he says, "past experience gives no encouragement to operative interference in cases of intussusception in infants less than one year old."

The advance made in the treatment of acute intussusception has been made mostly within the past fifteen years. In 1892, "Keith Monsarrat, by grouping together cases from tables provided by Gibson, Wiggin, Barker, Pitts, Eves, and D'Arcy Power, obtained a total of 374 cases that had been operated upon; 181 were cured and 193 died, showing a mortality of 51.7 per cent." (Clubbe). Since that time the mortality has been practically reduced to the present very encouraging figures.

From the foregoing facts one may gather some bedside suggestions that bear directly on the treatment of acute intussusception. Intussusception is another name for internal strangulated hernia. The symptoms, except the tumor, are in almost all cases evident and striking even to the layman; and the diagnosis is therefore comparatively easy to the medical observer. Where the tumor is not easily felt, we fail in our whole duty to the patient if we do not employ a general anæsthetic for diagnosis instead of waiting to recognize the tumor later without it. Treatment ought to be surgical and practised not only within the first twenty-four hours but within the first twelve hours, like the treatment of any other form of strangulated hernia, remembering that in those cases where gangrene occurs the process may be more rapid than other forms of hernia. Laparotomy and manual reduction offer the patient the best chance of recovery. Mechanical agents in reduction short of direct manipulation—such as air, gas, water, oil, etc., while they are free from the danger of atmospheric exposure and handling of the gut, are objectionable for the reason that we do not know, without laparotomy, the condition of the intestine to be reduced, nor whether, except by waiting, it has been reduced. While young infants operated on for the relief of invagination show a relatively high mortality with very early operative interference we may expect a low mortality—at present 12.5 per cent.

REFERENCES.

The Lancet. April 4, 1903, Bath Royal Hospital.
Barker. Archiv fur klin. Chir., vol. lxxi, 1903.
Carwardine. The Lancet, Feb. 20, 1904.
Curnst, in Boston Med. and Surg. Jour., July 24, 1902.
Czerny. Deutsch. med. Wochenshrift, Feb. 9, 1905.
Dobson. The Lancet, April 25, 1903.
Dunbar. The Lancet, April 25, 1904.
Dunbar. Scottish Med. and Surg. Jour., Aug. 1906.
Erdmann. N. Y., Phil. Med. Jour., No. 20, 1904.
Erdmann. Med. Record, July 5, 1902.
Greig. Scottish Med. and Surg. Jour., Aug. 1906.
Hirschsprung. Mttlg. Ano. d. Greuzgeb. d. Und. u. Chir., vol. xiv, 1904·5.
Kredel. Munich Med. Wochenshrift, No. 39, 1903.
Marnoch. Scottish Med. and Surg. Jour., Aug. 1906.
McGregor. Scottish Med. and Surg. Jour., Aug. 1906.
McGregor. Glasgow Med. Jour., lx, 1903.
Morgan. The Lancet, April 18, 1903.
Rigby. The Lancet, Feb. 7, 1903.
Roper. The Lancet, April 30, 1904.
Thyne. Scottish Med. and Surg. Jour., Aug., 1906.
Wallace. ANNALS OF SURGERY, xli, 1905.
Wallis. The Lancet, June 11, 1904.
Webb. The Lancet, Oct. 3, 1903.
Weill and Frankel. Bull. de la Soc. Anat. de Paris, 1896.
Weiss. Centralblatt f. d. Greuzgeb. d. Und. u. Chir., 1899.
Clubbe. "On Intussusception." Young J. Pentland, Edinburgh and London, 1907.
Eliot. Tran Am. Surg. Assoc., vol. xxiv.